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DESCRIPTION OF
8, 10, 12, 14, AND 16 INCH
SEACOAST GUNS
AND THEIR BREECH MECHANISMS
AND
INSTRUCTIONS FOR THEIR CARE

(*NINE PLATES*)

JANUARY 9, 1905
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REVISED JULY 20, 1912
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This Manual is published for the information and government of the Regular Army and National Guard of the United States.

By order of the Secretary of War:

WILLIAM CROZIER,
Brigadier General, Chief of Ordnance.

UNIV. OF CALIFORNIA

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8-INCH GUNS.

The bodies of these guns are composed entirely of steel, and consist of a tube, jacket, breech bushing, and A, C, and D hoops. The number of hoops has been successively reduced as steel manufacturers have become able to make larger forgings. The greater length of the hoops in the later constructions has much increased the stiffness of the guns.

MODEL OF 1888.

The tube is enveloped by the jacket and six C hoops. It is inserted into the jacket from the breech end, and a shoulder upon its exterior abuts against a corresponding one in the jacket near the front end of the latter. The jacket projects to the rear of the tube a sufficient distance to allow room for the screw box or breech recess. The jacket and C1 hoop, the C1 and C2 hoops, and the C2 and C3 hoops are not directly locked together. The C3 and C4, the C4 and C5, and the C5 and C6 are locked together by a lip on the forward hoop overlapping the lip on the rear one—the contact surface between the lips being a frustum of a cone with the smaller base at the breech end. The outside diameter of the tube is successively reduced from the front end of jacket to the muzzle by six shoulders. In front of the C5 hoop is a key ring which, being part in a groove in the tube and part in front of the hoop, prevents forward motion of any of the C hoops in rear. The C6 hoop is fastened to the tube by three radial securing pins.

Overlapping the front end of the jacket and covering the C1, C2, and part of the C3 are the two D hoops locked together by lips similar to those on the C hoops and having three radial securing pins passing through the D2 into the C3 hoop. Five A hoops, the second of which is the trunnion hoop, cover the jacket and part of the D1 hoop. The trunnion hoop has the shock of discharge transmitted to it through a shoulder on the jacket.

Into the portion of jacket projecting beyond the breech of the tube is screwed the steel breech bushing, which on its interior is threaded to receive the breechblock. The breech bushing is secured against unscrewing by four spline screws, halved into it and the jacket. A space of 0.05 inch is left between the breech of the tube and the breech bushing. At the interior of this joint there is a copper ring, given a compression of 0.01 inch between the tube and bushing. The bore of the gun is composed of the following parts, commencing at the breech end of the tube: Gas-check seat (conical), powder chamber (cylindrical), centering slope, forcing slope, main bore.

The centering slope is for the purpose of bringing the axis of the projectile in line with the axis of the bore, the copper rotating band on the projectile also stopping the projectile at its proper distance forward by seating on this slope. At the junction of this slope and the forcing slope the rifling commences. The tops of the lands at this point are cut down so that less power is required at first to force them through the copper rotating band. They attain their full height at the front end of the forcing slope. The twist of the rifling increases from 1 turn in 50 calibers at its origin to 1 in 25 at a point 16 inches back from the muzzle and retains this latter twist, uniform, up to the muzzle.

The breech mechanism consists of the breechblock, obturator, breech plate, rotating crank and gear, tray, translating roller, translating crank, tray latch, tray back latch, and hinge pin.

The principal parts of the breechblock are the three threaded sectors, three slotted sectors, two guide grooves, and translating stud.

The breechblock is threaded with a V thread with rounded top. The rear portion is left unthreaded to prevent the entrance of dust. The threaded portion is divided into six equal segments, three threaded and three slotted. The two guide grooves are cut in the bottom-slotted sector, 30° each side of the lowest element of the unlocked breechblock. They fit upon and pass over the rails of the tray when the block is drawn to the rear.

The translating stud, attached to the rear face of the breechblock in a slotted seat by a screw, projects radially from the face of the block. When the latter is rotated the 60° necessary to unlock it, the stud revolves into the groove in the translating roller.

The obturator consists of the obturator spindle, pad, front and rear split rings, small split ring, filling-in disk, obturator nut with clamp screw, and the obturator-spindle washers.

The vent is drilled through the spindle, in the front of which there is a copper bushing plug forced into an undercut on the face of the mushroom head. This bushing may be replaced when badly eroded. The rear end of the vent channel is finished to receive an obturating primer used to ignite the charge.

Pads manufactured prior to September, 1908, are composed of asbestos and mutton tallow; those manufactured subsequent to that date are composed of 3 parts asbestos and 1 part nonfluid oil and are marked in black letters "N. F. O."

The front and rear split rings are of steel, split diagonally through one side. They are slightly larger than the conical seat, and are sprung together in being forced into place. The small split ring is of similar construction, but slightly smaller than the spindle. The filling-in disk acts as a washer in rear of the pad. A shoulder on its front face supports the interior edge of the rear split ring, and a fillet on the rear face of the obturator-spindle head performs the same office for the front split ring. The obturator nut is screwed on the rear end of the spindle with a right-hand thread. It draws the obturator-spindle head and pad to a bearing against the face of the block. It abuts against the spindle washers and has under its front edge a thin steel spring washer, designed to keep out dust, and called the dust cover. The nut is provided with a clamp screw to prevent accidental unscrewing.

The four obturator-spindle washers are alternately bronze and steel. They reduce the friction between the obturator nut and the rear face of the breechblock recess, enabling the block to be rotated independently of the gas check, leaving the latter in its seat until the breechblock is unlocked. They are assembled with a bronze washer in front and the others alternating steel and bronze.

The breech plate is a bronze or steel casting attached to the breech face of the gun by 12 large screws. Its function is to cover the rotating mechanism and connect the tray with the gun by means of the hinge pin. On it are mounted the rotating pinion and its bushing, the rotating ring actuated by it, the bronze bushing seat of the rotating ring, and the tray back latch. On its rear surface are the hinge-pin lugs and rear-sight seat. A recess in its face acts as a catch for the tray latch.

The bronze bushing for the rotating ring is permanently attached to the breech plate by four screw bolts in a recess in its front face. It supports the rotating ring in rear and on its outer surface. It is lubricated by oil channels in its face.

The rotating mechanism for unlocking the breechblock consists of the rotating ring, rotating pinion, rotating crank, and associate parts.

The steel rotating ring encircles the breechblock and is mounted in the bronze bushing. From this ring projects radially the gear segment of 70 degrees, in which gear teeth are cut. The rotating ring fits over the cylindrical portion of the block, with a lug extending inward into the upper right-hand slotted sector, prolonged to the rear to receive it. It acts as a key in this slot to constrain the breechblock to rotate. When the latter is withdrawn from the screw box the slotted sector slides from under the lug.

The rotating pinion is a small gear whose function is to rotate the rotating ring into the gear segment of which it meshes. Its journal, mounted in a bronze bushing seated in the upper part of the breech plate, extends to the rear beyond the face of the breech plate, and has the rotating crank mounted upon its squared end, secured by the rotating-crank nut and pin. By it the pinion is turned, which rotates the gear segment, and in turn the block. Over the two faces of the pinion there are oil holes, closed by screws, for the lubrication of the rotating mechanism.

There is a spring catch called the rotating-crank lock, mounted on the rear face of the rotating crank, by which the gear system is locked when the breech is closed and the block is rotated to its locked position. This lock consists of two locking bolts, each controlled by a spiral spring, which acts to hold the bolts down in the locking recess in the breech face of the gun. These locking bolts act alternately—that is, one locks the rotating crank when the breech is closed and ready for firing, and the other locks the rotating crank in its horizontal position when the breech is open, ready for loading. These bolts are manipulated by means of a small crank, which is provided with inclined or beveled surfaces at its pivoted end. These surfaces come into engagement with lugs formed on the outer end of the locking bolts, and by swinging the small crank to the right the breech can be opened, and to the left the breech can be closed. The handle of the rotating crank is covered with a loose sleeve to facilitate turning.

By the rotation of the breechblock the translating stud is revolved into the thread of the translating roller and the block is in position to be drawn directly to the rear, out of the breech recess into the tray.

The tray is of bronze, mounted in rear of the breech, supported by a hinge pin on the right-hand side, in lugs cast on the breech plate. The parts are the tray proper, the translating roller and crank, the tray latch, and the catch for the tray back latch.

The translating roller is seated in a right-hand thread in the upper surface of the body of the tray. It has two independent threads cut in opposite directions on its surface. The translating stud engages in the left-hand thread in the roller. The translating crank is mounted on the squared end of the roller. The rotation of this crank causes the roller to unscrew in its right-hand thread, and hence travel back in the tray, drawing the breechblock with it. It also causes the translating stud attached to the breechblock to travel as a nut in the left-hand thread. Thus a double motion of translation is given to the beechblock, drawing it onto the tray by fewer revolutions of the crank than if either were used singly. In the reverse motion the tray latch serves to secure the tray to the face of the breech in entering the block into its seat in the screw box. It is mounted in a longitudinal slot in the web on the underside of the tray on the tray-latch pivot. Its front end terminates in a hook, which engages in a catch recessed in the breech plate. On its rear end is a transverse handle. The tray-spring bolt, mounted in the tray above the latch, holds it so that it can not be unlatched so long as its bolt is covered by the translating roller. When the latter is quickly withdrawn beyond it, the relation between the excess of weight in front of the tray-latch pivot and the tension of the bolt spring is such that the jar will unlatch it. Just in rear of the latch spring is a bolt, passing through the web of the tray and into a recess in the roller when the block is withdrawn, thus preventing any motion of the block to the front when in loading position. This bolt is operated by a lever hinged to the web of the tray, one end entering a slot in the bolt, the other joined to a link, which, in its turn, is joined to the tray latch. When the latch is unfastened its rear end is forced downward by the spring bolt, thus, through the connections, raising the lock bolt into its seat in the roller; when the latch is fastened, the lock bolt moves downward out of its seat.

The tray may then be swung about its hinge pin until caught by the tray back latch, thus uncovering the screw box. The tray back latch is mounted in a recess in the breech plate, through which its handle protrudes on the left and its catch end on the right. Its pivot is a screw bolt passing through the lower hinge ear, hinge pin, and breech plate. Its latch lip engages in the tray back-latch catch on the diagonal web of the tray. It may be released by lifting the handle or pressing down the latch end.

The hinge pin is a cylindrical bar mounted in two ears on the right side of the breech plate. An oil hole in the upper end of hinge pin permits of the pin being lubricated. It is entered from below and held in position by the same screw bolt upon which the tray back latch is pivoted.

ACTION OF BREECH MECHANISM.

When the breechblock is in position for firing, its threads are in bearing with those in the breech recess; the rotating crank is vertical; the rotating-crank lock bolt is in bearing in its recess. The translating stud is 60 degrees to the left of its seat in the roller; the tray latch is engaged in its catch; the rotating ring is rotated to its extreme right-hand position and the gas-check pad is in its seat.

To open the breech.—Turn the rotating-crank lock handle 45 degrees to the right; turn the rotating crank one and three-fourths turns in the direction of the hands of a clock, as indicated by the arrow marked "open" on the breech plate, until the translating stud turns into the translating-roller thread; one of the rotating-crank lock bolts will be opposite its seat in the hardened-steel lock plate, and the guide grooves in the lock opposite the guide rails of the tray. Turn the translating crank in the counterclockwise direction three turns, ending with a quick motion to bring the block into its final position in the tray with a jar which will release the tray latch. Swing the tray about the hinge pin till the tray back latch engages in the catch.

To close the breech.—Release the back latch; swing the tray to the face of the breech; reverse the above-described motion of the translating crank, then that of the lock bolt, then that of the rotating crank.

Guns mounted on barbette carriages have been provided with a modified back-latch catch in order to limit the swing of tray in the open position. This is necessary to prevent interference between the translating-crank handle and the gun carriage when the gun is elevated and the breech is open.

If, after firing, the breechblock can not be unlocked by the rotating crank, fit the rotating lever into the slots in the block and endeavor to turn the block. If this fails, remove the obturator nuts and washers and unscrew the block, leaving the obturator in the gun. If the block can not be unscrewed, remove the tray and breech plate. Support the tray by blocking and take out the tray back-latch pivot and remove the hinge pin and tray. Then support the breech plate by blocking and turn out the breech-plate screws, loosening all before any are entirely removed. Take out the top one and the side ones last. To avoid marring the thread, let one man hold a heavy screw driver in the slot and a second turn its blade with a screw wrench, catching the blade near the screw head. Put on the rotating lever or the bar through the handles and unscrew the block. The breech plate should not be taken off unless it be absolutely necessary. Its parts should always be well oiled. If it should be found necessary to remove it, an eyebolt, which screws into the oil hole, is provided for conveniently handling it. If the block can be unlocked but not drawn back, aid the translating roller by gently ramming on the face of the obturator spindle, interposing a wooden block between the rammer and the obturator spindle.

SEACOAST FIRING MECHANISM, MODEL OF 1903.

The principal parts of the firing mechanism are hinged collar, housing, slide, and firing leaf.

The hinged collar embraces the rear end of the spindle, two ribs on its inner surface engaging in corresponding grooves in the spindle.

The housing screws over the hinged collar, which is threaded to receive it, and a spring catch locks the collar to the housing when it is fully screwed home. The collar is thus prevented from opening and secures the housing to the spindle.

A guide bar projects from the right side of the housing into a longitudinal groove cut in the block recess and causes the housing to rotate with the block.

The slide travels vertically in grooves cut in rear face of the housing and when in its lowest position holds the primer to place in the primer seat. Its motion is limited by the slide stop on the left side of the housing. The slide catch serves to lock it to place when lowered, and to support it at the proper height to allow the primer to be inserted when raised.

The ejector is an L-shaped piece with trunnions at its angle, about which it swings, and which enter two slots cut for them in the housing. The lower arm of this extractor is fork-shaped and hangs over the mouth of the primer seat under the head of the primer. The horizontal arm projects to the rear into a recess in the slide, and when the latter is lifted this arm is carried upward and the ejector rotated about its trunnions so as to throw the horizontal arm to the rear, ejecting the primer.

The firing leaf is pivoted to the slide at its upper end. It has a vertical slot cut in its lower edge through which the wire of the primer projects when the slide is in its lower or locked position. At the right-hand lower corner of the leaf is an eye into which the lanyard is hooked for friction firing. When the leaf is drawn to the rear it engages the button on the end of the primer wire, draws the wire out, and fires the primer frictionally.

Electric connection with the primer is made through the arms of the contact clip which embrace the head of the primer. The contact clip is secured to the rear face of the leaf.

The electric cable terminal is made of a piece of copper thimble flattened at one end, the flattened portion being provided with a hole for the reception of the contact clip plug. The terminal is attached to the firing cable by passing the wires of the cable through the thimble and spreading the wires into notches cut into the terminal, and then soldering. The terminal is attached to the contact clip by means of the contact clip plug. The other end of the cable is fitted with the circuit-breaker contact pin. This is attached to the firing cable by stripping the insulation from the cable, passing the wires up into the pin, and dropping solder into holes provided therein for soldering the contact pin to the cable.

In order to prevent possible short circuiting between the primer body and the firing leaf, the contact clip nut should be tightly set up.

A safety bar prevents accidental firing of the piece by lanyard before the breech is locked; and a circuit breaker serves to prevent firing the piece by electricity before the breech is locked.

The first motion of rotation of the block to unlock the breech forces the safety bar inward so as to engage the leaf and prevent its being drawn to the rear, while at the same time the electric circuit is broken by the same movement of rotation.

A safety bar on the right side of the housing engages a groove in the firing leaf and prevents the latter from being drawn to the rear before the breechblock is rotated to its locked position. The last part of the motion of lowering the slide makes electric connection with the primer.

It will be seen from this that accidental firing of the piece is impossible until the breech is locked and the slide of the firing mechanism is in its lower or locked position.

The circuit breaker is of bronze and consists of two principal pieces, which are brought together when the block is rotated to its locked position. A plunger working under the pressure of a spring serves to make electric contact between the two pieces. Both parts of the circuit breaker are insulated from the piece by vulcanized fiber. The electric cable is attached to the circuit breaker by a spring fork.

INSTRUCTIONS FOR THE CARE AND USE OF SEACOAST FIRING MECHANISM, MODEL OF 1903.

NOTE.—While this mechanism forms part of a heavy gun, it is in itself small and light; the several parts are very closely adjusted, and it has been necessary to make the clearances very small. *The greatest care must be exercised, therefore, in keeping the mechanism well oiled and free from rust and dirt.*

It should not be left on the gun when not in use, but should be kept habitually in the small box provided for it, and stored in the armament chest.

TO ASSEMBLE THE MECHANISM ON THE GUN.

(*a*) Clasp the hinged collar over the end of the spindle with the two ribs of the collar engaging in the corresponding grooves of the spindle, keeping the hinge at the top.

(*b*) Take the mechanism in the right hand, holding the collar with the left, and put the mechanism over the end of the collar, screwing the latter to the left until the catch on the underside of the mechanism engages and locks it to position. While doing this, see that the guide bar which projects from the right side of the mechanism enters the groove cut in the breechblock for it, and that the pin on the safety-bar slide (which is attached to the gun) enters the hole in the outer end of the safety bar of the mechanism.

Do not attempt to use the mechanism until it is absolutely certain that the collar has been screwed entirely home and locked.

(*c*) After the primer has been inserted lower the slide until the catch engages in the notch of the housing.

Be sure the slide is entirely down before attempting to fire the piece; otherwise the primer may be blown to the rear, endangering the lives of the detachment.

TO DISMOUNT THE MECHANISM.

(*a*) To remove the mechanism from the spindle, draw the collar catch to the rear and unscrew the hinged collar.

(*b*) To remove the slide from the housing, draw the slide stop out to the left as far as it will go. The slide may then be lifted from the housing.

(*c*) To remove the firing leaf and slide catch from the slide, start the split pin which passes through the leaf pivot by pressing upon it and then draw it out. The pivot is then free to be removed, and its removal frees the leaf and slide catch from the slide.

(*d*) The collar catch may be removed by unscrewing the screw at the lower edge of the housing.

(*e*) The slide stop may be removed by unscrewing it from the housing with the wrench provided for that purpose. The slide stop should not be removed except when necessary to repair it or to replace a broken spring.

(*f*) The contact clip may be removed from the leaf by unscrewing the nut on the underside of the leaf.

NOMENCLATURE.

Housing.
Hinged collar.
Collar catch.
Collar catch spring.
Collar catch screw.
Ejector.
Guide bar.
Slide.
Slide stop.
Slide-stop spring.
Slide-stop housing.
Slide-stop nut.
Slide-stop nut pin.
Slide catch.
Slide-catch spring.
Firing cable, short length, for breech of gun.
Firing leaf.
Firing-leaf spring.
Firing-leaf spring screw.
Firing-leaf pivot.
Firing-leaf pivot pin.
Contact clip.
Contact-clip housing insulation.
Contact-clip housing nut.
Contact-clip housing nut insulation.
Electric cable terminal.
Safety bar.
Wrench and screw driver.
Collar operating pin.

Parts attached permanently to the gun.

Safety-bar slide.
Safety-bar slide housing, not on mortars.
Safety-bar slide housing screws, not on mortars.
Safety-bar slide end piece,[1] on mortars only.
Safety-bar slide stop screw, on mortars only.
Safety-bar slide end piece screw, on mortars only.
Circuit-breaker housing.
Circuit-breaker housing plug.
Circuit-breaker housing insulation.
Circuit-breaker screws (2).
Circuit-breaker screw insulation.
Circuit-breaker contact piece.
Circuit-breaker contact piece insulation.
Circuit-breaker contact piece screws.
Circuit-breaker contact piece screws insulation.
Circuit-breaker contact pin.
Circuit-breaker contact spring.
Contact fork (2).
Contact-fork spring.

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[1] Attaches to vent shield body, which is now called safety-bar slide.

MODIFICATIONS OF MODEL OF 1888.

These guns differ from the model of 1888 mainly in the number of hoops and their arrangement. The breech mechanism is of the same general design; and the later improvements therein will, as far as practicable, be extended to the earlier guns in case of damage to, and necessary replacement of, any of the parts.

NOTE.—The same firing mechanism is used on all 8, 10, 12, 14, and 16 inch guns, and 12-inch mortars.

As there are some minor details not specified here, wherein guns of the same model differ slightly from each other, it is essential that in making requisition for spare parts to replace breakages the gun number, as well as caliber and model, and the *place of manufacture*, should be stated; e. g., "8-inch gun No. 13, Model of 1888, Watervliet Arsenal."

Watervliet Arsenal guns are of the following models:

Nos. 1 to 13, inclusive, Model of 1888.
Nos. 14 to 35, inclusive, Model of 1888 MI.
Nos. 36 to 57, inclusive, Model of 1888 MII.

Model of 1888 MI has the number of C hoops reduced to five. The C1 and C2 are increased in length, and the length of the jacket forward of its exterior shoulder increased, so that only the C1 and part of the C2 are covered by the D row. The D row remains the same length, although the sizes of the D1 and D2 are altered.

The number of securing pins for the C row is increased to four. The number of securing pins for the D row remains three, as in the original model.

The key ring in front of the C5 hoop in the Model of 1888 is herewith omitted. The number of shoulders on the tube forward of the jacket is reduced to four, all the C hoops having cylindrical bores.

Model of 1888 MII has the number of C hoops reduced to two, of D hoops to one, and of A hoops to four. The portion of jacket forward of its exterior shoulder is again increased in length. The D hoop envelops this front end of the jacket and part of the C1 hoop, and binds them together by means of a locking recess in the D hoop, which takes hold of a shoulder on the jacket and one on the C1 hoop. In order to assemble the D hoop with this locking recess, a clearance is necessarily left behind this hoop and in front of the jacket. Into this space a steel shoulder ring, made in two semicircles, is driven. There are no securing pins for the D hoop. The securing pins for the C2 hoops are four in number. Like the Model of 1888 MI, this model has no key ring. Of the A hoops, the A1 and A2 are the same as in the two preceding models, the alteration being in the hoops back of the trunnion hoop. The number of shoulders on the tube is reduced to four forward of the jacket, one under the jacket.

In the guns of this model the obturator nut on the spindle has left-hand thread, instead of right-hand, as in the two previous models.

The steel breech plate is replaced by a bronze one. A bearing for the rotating ring is formed directly in this plate, dispensing with the former bronze bushing. In these guns the number of screws for attaching the breech plate to the gun is reduced to eight.

PRECAUTIONS AND PRESERVATION.

Never, under any circumstances, should a hammer be used directly upon any part of a gun. If necessary to use one, a piece of copper, wood, or other cushion should be interposed. All parts are so fitted that little or no force should be necessary for assembling or dismantling.

Projectiles should be wiped free of sand or dirt before loading and must never be entered in the gun without first placing the loading tray in the breech recess.

Care should be had that the breech mechanism is kept free of rust, dirt, and residue, and that before each day's firing the parts are well oiled through the holes marked "Oil hole."

The pressure-plug seats should be closed either with dummy plugs or the pressure gauges. A copper washer must invariably be placed beneath the pressure gauges or the dummy plugs during firing to protect the screw threads from the powder gases. The obturator nut should always be screwed up so that there is sufficient friction to make a slight effort necessary to turn the obturator in its seat. During the firing the pad should be frequently oiled and any residue removed from the chamber.

To prolong the life of gas-check pads the pad covering should be covered with a mixture of graphite and No. 4½ lubricant (equal parts by weight). The mixture should be thoroughly incorporated by thoroughly rubbing into the pad covering and a fresh application should be made before each target practice.

If a gas-check pad is torn or burned in firing it should be replaced. *If a new one is not at hand* the injured one *may* be repaired by warming it slightly, pressing back the asbestos and nonfluid oil mixture, and sewing a piece of light canvas over the rent. It will be formed to shape in firing.

During firing, when necessary, the gun should be washed out and the mechanism cleaned with oil. After firing, the gun should be washed out, the mechanism cleaned with oil, and the bore and mechanism lubricated with light slushing oil. At no time should the mechanism be washed off with water, as it rusts the surfaces about the pad and split rings, etc. It should be kept habitually, when not in use, with muzzle slightly depressed, muzzle and breech covers in place, and the breech mechanism should be examined and worked frequently to insure its being always in working order.

A history of each round fired should be kept for each gun.

The principal weights, dimensions, etc., of the 8-inch guns are as follows:

Weight	pounds	32,218
Weight	tons	14.64
Total length	inches	278.5
Length of bore	calibers	32
Maximum diameter of breech	inches	30
Diameter of muzzle	do	14
Diameter of trunnions	do	10
Length of trunnions	do	6
Distance between rimbases	do	32.5
Distance of axis of trunnions from muzzle	do	183
Rifling:		
Number of grooves		48
Width of grooves	inch	0.3736
Depth of grooves	do	0.06
Width of lands	do	0.150
Twist of rifling	calibers	1 in 50 to 1 in 25 at 16 inches from muzzle.
Powder chamber:		
Diameter	inches	9.5
Length	do	51.00
Capacity	cubic inches	3,617
Total capacity of bore	do	14,138
Powder charge:		
Kind of powder		Nitrocellulose.
Weight of charge	pounds	83
Density of loading		0.6352
Projectile:		
Weight of projectile (filled)	pounds	316
Ratio of weight to weight of piece		1 to 102
Length of projectile	calibers	3.5 4.5
Sectional density $=\frac{W}{d^2}$		4.938
Travel of projectile in bore	inches	205.25
Muzzle velocity	foot-seconds	2,200
Pressure per square inch in powder chamber	pounds	38,000
Muzzle energy	foot-tons	10,615
Penetration in Krupp armor, capped projectile:		
Muzzle	inches	12.27
1,000 yards	do	11.2
5,000 yards	do	7.1

10-INCH GUNS.

These guns are entirely of steel; each is composed of a tube, a jacket, A, B, C, and D hoops, and the breech mechanism. The number of hoops has been reduced in the different models as steel manufacturers have become able to produce larger forgings. The greater length of the hoops in the later constructions has much increased the stiffness of the guns.

MODEL OF 1888.

The tube is enveloped by the jacket and seven C hoops. The jacket projects to the rear of the tube a sufficient distance to allow room for the breech recess. A shoulder near the front end of the jacket abuts against one on the tube. There are two shoulders at the rear end of the tube, but they are not in contact with the corresponding jacket shoulders, there being a clearance of 0.05 inch. The tube and jacket are united by two steel coupling pins, which are driven into holes drilled partly in the tube and partly in the jacket, at the front end of the latter. The pins are inserted tangentially instead of radially, as was the case in the type gun. The C1, C2, and C3 hoops are cylindrical. C1 abuts against the forward end of the jacket and against the shoulder on the tube. Hoops C4, C5, C6, and C7 are shrunk on the tube in steps, their exterior diameters gradually decreasing to the muzzle. The C hoops are locked together by the lip of the one in front fitting over a lip on the one just in rear, and hoop C7 is locked to the tube in front by three securing pins 120 degrees apart.

The D1 hoop, by means of a recess on its interior, locks the jacket to the C1 hoop, shoulders being left on the jacket and hoop for that purpose.

In front of the C6 hoop is a key ring which, being part in a groove in the tube and part in the front of the hoop, prevents forward motion of any of the C hoops in rear.

The shoulder ring, in two semicircles, is driven between the front shoulder of the jacket and the rear end of the D1 hoop to fill the space left to allow for longitudinal expansion in shrinking on the D1 hoop.

Hoop D2 connects with D1 by means of a lip and recess, abuts against the shoulder on C2, and has three securing pins, 120 degrees apart, passing through, near its front end, into the C hoop underneath.

The five A hoops extend in the order of their numbers from a shoulder on D1 to the rear end of the jacket, the last hoop containing a recess which fits over a corresponding projection on the jacket, locking the two surfaces together.

The B hoops envelop the A hoops, breaking joints with them. The trunnion hoop, B1, abuts against a shoulder on the A1 hoop. Into the jacket, at the rear, is cut the screw thread for the breechblock.

In a few guns the exterior of the extreme breech end of the tube is beveled off, and a copper packing ring driven into the recess thus formed betwen tube and jacket.

The bore of the gun is composed of the following parts, commencing at the breech end of the tube: Gas-check seat (conical), powder chamber (cylindrical), centering slope, forcing slope, main bore.

The centering slope is for the purpose of bringing the axis of the projectile to the axis of the bore, the copper rotating band of the projectile also stopping the projectile at its proper distance forward by seating in this slope. At the junction of this slope and the forcing slope the rifling commences. The tops of the lands at this point are cut down so that less power is required at first to force them through the copper rotating band. They attain their full height at the front end of the forcing slope.

The breech mechanism consists of the breechblock, obturator, breech plate, rotating crank and gears, tray, translating roller, translating crank, tray latch, tray back latch, and hinge pin.

The principal parts of the breechblock are the threaded sectors, the slotted sectors, the guide grooves, and the translating stud.

The breechblock is threaded with a V thread with rounded top. The rear portion is left unthreaded to prevent the entrance of dust. The threaded portion is divided into eight equal sectors, four threaded and four slotted. The two guide grooves are cut in the two bottom slotted sectors, 30 degrees each side of the lowest element of the unlocked breechblock; they fit upon and pass over the rails of the tray when the breechblock is drawn to the rear. The breechblock is slotted across its breech face for a rotating lever, which may be attached by two screw bolts.

The translating stud projects radially from the rear face of the breechblock and is secured in its seat by a screw. When the breechblock is rotated the 45 degrees necessary to unlock it, the stud revolves into the groove in the translating roller.

The obturator consists of the obturator spindle, pad, the front, rear, and small split rings, the filling-in disk, the obturator nut, and the obturator-spindle washers.

The vent is drilled through the spindle, in the front of which is a copper bushing forced into an undercut in the face of the mushroom head. This bushing may be replaced when badly eroded. The rear end of the vent channel is enlarged and fitted for an obturating primer used to ignite the charge.

The pads manufactured prior to September, 1908, are composed of asbestos and mutton tallow; those manufactured subsequent to that date are composed of 3 parts asbestos and 1 part nonfluid oil, and are marked, in black letters, "N. F. O."

The front and rear split rings are of steel, split diagonally through one side. They are slightly larger than the conical seat, and are sprung together in being forced into place. The small ring is of similar construction and fits tightly over the spindle. The gas-check disk acts as a washer in rear of the pad; a shoulder on its front face supports the interior edge of the rear split ring; a fillet on the rear face of the obturator-spindle head performs the same office for the front split ring. The obturator nut is screwed on the rear end of the spindle with a right-hand thread in the earlier guns, and in the later with a left-hand thread; it abuts against the spindle washers, draws the obturator-spindle head and pad to a bearing against the face of the block, and has under its front edge a thin steel spring washer, designed to form a tight joint over the recess for the spindle washers to prevent the entrance of dust, sand, etc. It is provided with a clamp screw to prevent accidental unscrewing.

The four obturator-spindle washers are alternately bronze and steel assembled with one of the former in front. They reduce the friction between the spindle nut and the rear face of the block recess, enabling the block to be rotated independently of the pad, leaving the latter in its seat until the block is unlocked.

The breech plate is a steel casting attached to the breech face by twelve large screws. On it are mounted the rotating mechanism, the securing latch, the hinge lugs, and the rear-sight seat. A recess in its face acts as a catch for the tray latch.

The rotating mechanism for the breechblock consists of the rotating ring, its bronze bushing, the rotating gears, and the rotating crank and associate parts.

The steel rotating ring encircles the breechblock and is mounted in the bronze bushing. From this ring projects radially the gear segment of 70 degrees, in which the teeth are cut. The gear ring fits over the cylindrical portion of the block, with a lug extending into the upper right-hand slotted sector, which is prolonged to the rear to receive it when the block is locked. This lug acts as a key in the sector to constrain the block to rotate, and when the latter is withdrawn from the screw box the slotted sector slides from under the lug.

The bronze bushing is attached to the breech plate by four screw bolts, and is lubricated by oil channels in its face.

The rotating gears are three in number—two single and one compound; the first, single, called the rotating-crank pinion, is solid with its journal, which works in bronze bushings and extends through the breech plate, the rotating crank being mounted on the rear end and secured thereon by a nut and pin. The intermediate gear, also single, works into the larger wheel of the compound gear. The latter is in one piece, forming two gears of different diameters; the smaller engages the gear segment, and thus, by the crank, the breechblock is rotated.

There is a spring catch called the rotating crank lock, mounted on the rear face of the rotating crank, by which the gear system is locked when the breech is closed and the block is rotated to its locked position. This lock consists of two locking bolts, each controlled by a spiral spring which acts to hold the bolts down in the locking recess in the breech face of the gun. These locking bolts act alternately—that is, one locks the rotating crank when the breech is closed and ready for firing, and the other locks the rotating crank in its horizontal position when the breech is open ready for loading. These bolts are manipulated by means of a small crank which is provided with incline or beveled surfaces at its pivoted end. These surfaces come into engagement with lugs formed on the outer end of the locking bolts, and by swinging the small crank to the right the breech can be opened, and to the left, the breech can be closed. The handle of the rotating crank is covered with a loose sleeve.

By the rotation of the block the translating stud is revolved into the thread of the translating roller, and the block is in position to be drawn directly to the rear out of the breech recess onto the tray.

The tray, of bronze, is mounted in rear of the breech, supported on the right-hand side by a hinge pin, secured by screws to lugs on the breech plate. The associated parts are the translating roller and crank, the tray latch, and the catch for the securing latch.

The translating roller is seated in a right-hand thread in the upper portion of the tray, and has also cut upon it a left-hand thread in which the translating stud works. The action of the crank causes the roller to unscrew in its right-hand thread, and the translating stud attached to the block to travel as a nut in the left-hand thread, drawing the block with it; thus the translation of the block is given by fewer revolutions of the crank than if either were used singly, and the translating roller has only to travel one-half the distance.

The tray latch secures the tray to the face of the breech; it is pivoted in a longitudinal slot on the underside of the tray, has the front end terminating in a hook lip, which engages with a catch in the breech plate, and has a transverse handle on its rear end. The tray spring bolt, mounted in the tray, holds the latch so that it can not be released while its bolt is covered by the translating roller. When the latter is quickly withdrawn beyond the bolt, the relation between the excess of weight in front of the latch journal and the tension of the tray spring bolt spring is such that the jar will unlatch the tray. Just in rear of the latch spring is a bolt passing through the web of the tray and into a recess in the roller when the block is withdrawn, thus preventing any motion of the block to the front when in the loading position. This bolt is operated by a lever hinged to the web of the tray, one end entering a slot in the bolt, the other joined to a link, which, in its turn, is joined to the tray latch. When the latch is unfastened, its rear end is forced downward by the spring bolt, thus, through the connections, raising the lock bolt into its seat in the roller; when the latch is fastened, the lock bolt moves downward out of its seat.

The tray latch being unfastened, the tray may be swung to the right until caught by the tray back latch; this last is mounted in a recess in the breech plate, through which its handle protrudes on the left and its catch end on the right; its pivot is a short screw, with countersunk head, located in the breech plate directly back of the tray hinge. The latch engages in a catch on the diagonal web of the tray, and may be released by lifting the handle or pressing down the latch end.

The hinge pin is mounted in two lugs on the right side of the breech plate; it is entered from below and held in position by a screw passing through the lower hinge lug on the breech plate, thus locking the pin to the breech plate. An oil hole in the upper hinge lug permits of the pin being lubricated.

ACTION OF BREECH MECHANISM.

When the breechlock is in position for firing, its threads are in bearing with those in the breech recess; the rotating crank is vertical; the rotating-crank lock bolt is bearing in its recess. The translating stud is 45 degrees to the left of its seat in the roller; the tray latch is engaged in its catch; the rotating ring is rotated to its extreme right-hand position, and the gas-check pad is in its seat.

To open the breech.—Turn the rotating-crank lock handle 45 degrees to the right, turn the rotating crank in the direction of the hands of a clock, as indicated by the arrow marked "open" on the breech plate until the translating stud is in the translating-roller thread; one of the rotating-crank lock bolts will be opposite the hardened steel lock plate, which has a recess in its head to receive it, and the guide grooves in the block opposite the guide rails of the tray. Turn the translating crank in the counter-clockwise direction four times, ending with quick motion to bring the block into its final position in the tray with a jar, which will release the tray latch; swing the tray until the tray back latch engages in the catch.

To close the breech.—Release the back latch; swing the tray to the face of the breech; reverse the motion of the translating crank, then that of the rotating-crank lock handle and that of the rotating crank.

Guns mounted on barbette carriages have been provided with a modified back-latch catch in order to limit the swing of tray in the open position. This is necessary to prevent interference between the translating-crank handle and the gun carriage when the gun is elevated and the breech is open.

If, after firing, the block can not be unlocked by the rotating crank, put on the rotating lever and endeavor to turn the block. If this fail, remove the obturator nut and washers and unscrew the block, leaving the obturator spindle in the gun. If the block can not be unscrewed, remove the tray and breech plate. Support the tray by blocking and take out the hinge-pin bolt and remove the hinge pin and tray. Then support the breech plate by blocking and turn out the breech-plate screws, loosening all before any are entirely removed, and taking out the top and side ones last. To avoid marring the thread, let one man hold a heavy screw driver in the slot and a second turn its blade with a screw wrench, catching the blade near the screw head. Put on the rotating lever and unscrew the block. The breech plate should not be taken off unless it be absolutely necessary; if necessary to remove it, an eyebolt, which screws into the oil hole, is provided for convenience in handling. If the block can be unlocked, but not drawn back, aid the translating roller by gently ramming on the face of the obturator, interposing a hardwood block between the rammer and the obturator.

As there are some minor details not specified here, wherein guns of the same model differ slightly from each other, it is essential that, in making requisitions for spare parts to replace breakages, the gun number, as well as caliber and model, and the *place of manufacture*, should be stated: e. g., "10-inch gun No. 5, Model of 1888, Watervliet Arsenal."

The firing mechanism is the same as for the 8-inch gun.

MODEL OF 1888, MODIFICATIONS I AND II.

These guns differ from the model of 1888 mainly in the number of hoops and their arrangement, the breech mechanism being the same, except in some minor details.

Model of 1888 MI has five C hoops instead of seven, and four securing pins near the muzzle instead of three.

Model of 1888 MII has the C hoops reduced to two, the D hoops to one, the A hoops to three, and the B hoops to three; there are four securing pins near the muzzle and none through the D hoop; the coupling pins are omitted.

In some of the guns, model of 1888 MII, the steel breech plate and bronze bushing are replaced by a bronze plate. For 10 and 12 inch guns, models of 1888 and 1888 modified, a new design of tray has been provided and when the trays of original design have become sprung or have sagged to such an extent that the translation of the breechblock is impeded, a new tray should be ordered.

MODEL OF 1895.

The guns of this model, excepting the breech mechanism, are essentially the same as those of model of 1888 MII, although some of the dimensions are slightly different, the breech recess being shorter and of greater diameter, and there is but one shoulder between jacket and tube at the breech end instead of two.

The breech mechanism is the Stockett. Its principal parts are the breechblock, the block locking device, the obturator, the tray, the tray latch, the hinge and its screws, the hinge pin, the compound gear, the wormwheel, the worm and shaft, the hinge-pin nut, the rotating crank, the ball bearings, and the bronze bushings for the worm shaft.

The breechblock has six threaded and six slotted sectors. From the rear face at the right projects a rotating lug with teeth into which mesh the teeth of the compound gear. Projections on the upper and lower edges of this lug strike against the gear and limit the rotation of the block in both directions. In that slotted sector, which is at the same height as the compound gear, when the block has been rotated for withdrawing, is cut a translating rack which, in conjuction with the compound gear, serves to withdraw the block, swing it and the tray into the loading position, and reverse these operations. The breechblock has two guide grooves, each 30 degrees from the lowest element of the block when in position for withdrawing, and ending in shoulders near the front face. There are also two short grooves, midway between the guide grooves and parallel to them, at opposite ends of the block and ending in inclined shoulders; they form seats for the toes of the tray latch when the block is withdrawn.

The block locking device consists of a bell-crank lever pivoted to the breech face of the gun near the upper end of the hinge pin, the longer arm of which is connected to a spring-controlled locking bolt, which is seated in the breech face of the gun, its lower end being engaged in a notch cut into the periphery of the block. The short arm of the bell crank is arranged to fit into a notch cut into a cap fitted to the upper end of the hinge pin. The bell crank is provided with an operating handle for controlling the locking bolt. Before an attempt is made to open the breech mechanism the block locking bolt must be tripped from its seat in the block. After it is tripped the breechblock can be rotated. During the rotation and translation of the block the short arm of the bell-crank lever is out of its notch in the hinge-pin cap and is bearing against the periphery of the cap. This holds or supports the locking bolt in its upward or unlocked position, in order that there will be no interference between the locking bolt and the breechblock when closing the latter. The locking bolt works automatically when closing the breech mechanism, but must be operated by hand before the breechblock can be rotated for opening the same.

The obturator is of the same construction as for the model of 1888 guns, except that ball bearings are used instead of spindle washers.

The tray is of steel, mounted in rear of the breech, and consists of two guide rails, a cylindrical hinge, and a heavy connecting web. It is supported by a hinge pin passing through two lugs on the hinge. The under central portion of the web is grooved longitudinally to furnish a seat for the tray latch; its front face has a seat for the tray-latch lock bolt and its spring, and the front portion of the tray-latch groove has a seat for the tray-latch spring.

The tray latch consists of the latch proper and its catch, the latch spring, the lock bolt, its spring, and the operating stud.

The latch proper is a steel lever, pivoted by the tray-latch pivot to the web of the tray; it has a toe and handle at the rear end, and a toe and hook at the front end. The front toe is bored through for the passage of the operating stud, and there is a seat on the upper surface of the latch for the latch spring.

The latch spring is spiral and is seated in the lower face of the web and the upper face of the front half of the latch.

The lock bolt is cylindrical and has a spiral spring in rear constantly urging it forward.

The operating stud, which controls the locking bolt, passes through the front toe of the latch.

The tray-latch catch is screwed to the breech by two screws and is of a shape to receive the hook of the latch.

The hinge is of steel and is assembled by seven screw bolts to the breech of the gun on the right-hand side; its rear face is flush with the breech, and has two lugs for the hinge pin; the lower end is bored out to receive the worm shaft and its bearings.

The hinge pin is cylindrical with a flange on top, a square surface for the bronze worm wheel beneath the lower lug, and a thread for a securing nut below the wheel. Just below the upper lug, and at opposite extremities of a diameter, are two splines, on which the compound gear is assembled. The upper lug hole is large enough to permit these splines to pass through, and the pin is correspondingly enlarged at the upper end.

The compound gear is assembled between the upper hinge lug and the hinge, and is secured from rotating on the pin by the splines that fit into two grooves on the inner surface of the gear. The latter is formed by first cutting large tooth-shaped screw threads and then cutting longitudinal grooves at regular intervals, thus forming a combined spiral gear (to rotate the block) and pinion (to operate on the translating rack).

The worm wheel is of bronze, is assembled on the squared surface of the hinge pin, and gears into the worm through an opening in the hinge.

A ball-bearing washer of steel is placed between the hinge and the lower hinge lug to reduce friction in swinging the tray and block.

The hinge-pin nut is screwed to the lower end of the hinge pin, and secures the assembled parts.

The worm shaft is of steel, working in two bronze bushings, the inner being a ring and the outer a nut screwed into the hinge. Between each end of the worm and the bronze bushings are placed hardened steel ball thrust bearings to diminish the friction due to the end thrust. The outer end of the shaft is squared to receive the crank, the handle of which has a loose-fitting brass sleeve.

ACTION OF BREECH MECHANISM.

When the breechblock is in position for firing, its threads are engaged in those of the breech recess, and it is provided with a locking bolt fitted in a recess in the breech face of the gun, having its lower end seated in a notch formed in the periphery of the block; the upper teeth of the rotating rack are engaged in those of the compound gear; the tray is latched to the breech; the rear toe of the latch projects above the upper surface of the tray; the front toe is on a level with this surface; and the rear face of this toe retains the latch-locking bolt in its recess.

To open the breech.—First release the locking bolt from its seat in the block by pressing downward on its handle. Turn the crank continuously toward the muzzle until the tray comes to rest against the hinge. As the crank is turned, the teeth of the compound gear, working in those of the rotating rack, cause the breechblock to rotate to the left until its guide grooves are opposite the guide rails of the tray; in this position the lower shoulder on the lug strikes the lower surface of the gear, preventing further rotation of the block. The teeth of the gear engage in the translating rack and the block is withdrawn, at the end of its travel striking an inclined surface on the rear toe of the tray latch, forcing it down against the action of the latch spring and thus unlatching the tray. The front toe of the latch rises and engages in its groove in the block; the locking bolt moves forward and enters its seat in the latch, forcing the operating stud to the front.

The block is prevented from moving to the rear on the tray by the bearing of the guide rails against the shoulders of the guide grooves, and from moving forward by the front toe of the latch. Since no further motion of the block relative to the tray is possible, the block and tray swing with the hinge pin to the right until the tray rests against the hinge. In this position the crank handle is horizontal and in front of the shaft, the weight of the former being sufficient to retain the block and tray in place without a back latch.

To close the breech.—Turn the crank to the rear. The block being locked to the tray, turning the crank to the rear swings both lock and tray to the left until the tray strikes the breech of the gun. The operating stud, projecting through the front of the latch, being pressed back by bearing against the breech, forces the lock bolt into its recess and releases the tray latch in front. The first forward motion of the block, after the tray strikes the breech, releases the rear toe of the latch and the latch spring forces the hook over the catch, thus locking the tray to the breech. The block, being now free to move forward, is forced home by the translating rack and gear and rotated to the right by the rotating gear until in the firing position, when the projection on the upper surface of the rack strikes the gear, preventing further motion.

The firing mechanism is the same as for model of 1888 guns.

MODEL OF 1900.

Guns of this model have the same breech and firing mechanism as guns of model of 1895. They differ from the latter in length and weight and in dimensions of the powder chamber. These differences can be readily seen by referring to plate giving sections of the guns.

The powder chamber of this gun has been modified by the addition of a fixed tray of gun steel permanently screwed in place, reducing the chamber capacity by 564 cubic inches.

10-INCH DUMMY GUNS, MODEL OF 1911.

The dummy 10-inch guns, model of 1911, are intended for use in armories for the instruction of State militia, Coast Artillery Reserves.

These guns are similar in appearance to the service 10-inch guns, model of 1895 M_I, have the same exterior dimensions, and use the same breech mechanism, except the parts are made of cast iron and a cheap grade of machinery steel.

The gun weighs approximately 29,500 pounds, including the breech mechanism, is composed of iron castings for the breech, muzzle, trunnions, and powder chamber, and commercial wrought-iron pipe for the main bore, which is not rifled.

The breech blocks should be made of steel and not cast iron, in order to prevent breakage of rotating rack teeth, also increase thickness of rack at root of gear teeth to prevent breakage of same. The exterior is made of steel plate 0.5 inch thick, secured in place by screws to the iron castings forming the breech, trunnion hoop, and muzzle frustum.

Filling-hole plugs have been provided on top of gun near the muzzle and in the breech face of the gun to provide means for adjusting the balance of the gun with sand or other suitable material.

PRECAUTIONS AND PRESERVATION.

Never, under any circumstances, should a hammer be used directly upon any part of a gun. If necessary to use one, a piece of copper, wood, or other cushion should be interposed. All parts are so fitted that little or no force should be necessary for assembling or dismantling.

Due to the steel plate construction of 10-inch dummy guns, great care should be taken in handling, when mounting or dismounting them from cars or their carriages, to prevent buckling or other injury. They should when practicable be handled or swung by means of the trunnions.

Projectiles should be wiped free of sand or dirt before loading and must never be entered in the gun without first placing the loading tray in the breech recess.

Care should be had that the breech mechanism is kept free of rust, dirt, and residue, and that before each day's firing the parts are well oiled through the holes marked "Oil hole."

The pressure-plug seats should be closed either with dummy plugs or the pressure gauges. A copper washer must invariably be placed beneath the pressure gauges or the dummy plugs during firing to protect the screw threads from the powder gases. The obturator nut should always be screwed up so that there is sufficient friction to make a slight effort necessary to turn the obturator in its seat. During firing the pad should be frequently oiled and any residue removed from the chamber.

If a gas-check pad is torn or burned in firing, it should be replaced. *If a new one is not at hand*, the injured one *may* be repaired by warming it slightly, pressing back the asbestos and nonfluid oil mixture, and sewing a piece of light canvas over the rent; it will be formed to shape in firing.

During firing, when necessary, the gun should be washed out and the mechanism cleaned with oil. After firing, the gun should be washed out, the mechanism should be cleaned with oil, and the bore and mechanism lubricated with engine oil No. 1. At no time should the mechanism be washed off with water, as it rusts the surfaces about the pad and split rings, etc. It should be kept habitually, when not in use, with muzzle slightly depressed, muzzle and breech covers in place, and the breech mechanism should be examined and worked constantly to insure its being always in working order.

A history of each round fired should be kept for each gun.

The principal weights, dimensions, etc., of 10-inch guns are as follows:

	Models of 1888.	Model of 1895.	Model of 1900.[1]
Weight .... pounds..	67,183	66,700	76,830
Weight .... tons..	30	30	34.3
Total length .... inches..	367.25	369.15	420.6
Length of bore .... calibers..	34	35	40.4
Maximum diameter of breech .... inches..	38.5	37.0	40.40
Diameter of muzzle .... do....	16.8	17.5	18.5
Diameter of trunnions .... do....	12	12	12
Length of trunnions .... do....	6.75	6.75	6.75
Distance between rimbases .... do....	42	42	42
Distance of axis of trunnions from muzzle .... do....	243.05	240.3	281.89
Actually, 243.65 inches, model of '88; 243.05 inches, models of '88 MI and MII; 281.89 inches, model of 1900.			
Rifling:			
Number of grooves	60	60	60
Width of grooves .... inch..	0.3736	0.3736	0.3736
Depth of grooves .... do....	0.06	0.06	0.06
Width of lands .... do....	0.15	0.15	0.15
Number of lands	60	60	60
Twist of rifling .... calibers..	1 in 50 at origin to 1 in 25 at 20 in. from muzzle.	1 in 50 at origin to 1 in 25 at 30 in. from muzzle.	1 in 50 at origin to 1 in 25 at 30.574 in. from muzzle.
Powder chamber;			
Diameter .... inches..	11.8	11.8	13.75
Length .... do....	65.09	65.48	70.396 Cylindroconical.
Capacity .... cubic inches..	7,120	7,120	9,478
Breech recess:			
Diameter over slotted sectors .... inches..	15.42	17.52	17.505
Length .... do....	16.2	14.25	15
Total capacity of bore .... cubic inches..	29,064	[2] 29,814 [3] 29,678	36,057
Powder charge, kind of powder	Nitrocellulose.	Nitrocellulose.	Nitrocellulose.
Weight of charge .... pounds..	162	160	182
Density of loading	0.6298	0.6220	0.5315
Projectile:			
Weight of projectile (filled) .... pounds..	604	604	604
Ratio of weight of projectile to weight of piece....	1 to 111.	1 to 110.	1 to 120.
Sectional density $\frac{w}{d^2}$	6.04	6.04	6.04
Travel of projectile in bore .... inches..	275.11	[2] 284.51 [3] 282.81	329.65
Muzzle velocity .... foot-seconds..	2,250	2,250	2,250
Pressure per sq. in. in powder chamber... pounds..	38,000	38,000	32,000
Muzzle energy .... foot-tons..	21.223	21.223	21.223
Penetration in Krupp armor, capped projectile:			
Muzzle .... inches..	15.84	15.84	15.84
1,000 yards .... do....	14.7	14.7	14.7
5,000 yards .... do....	10.3	10.3	10.3

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[1] Ten-inch guns, model of 1900, numbered 12, 13, and 14, are provided with this form of rifling: Number of grooves, 90; width of grooves, 0.2091 inch; depth of grooves, 0.07 inch; width of lands, 0.14 inch; number of lands, 90; twist of rifling, 0 turns at origin to 1 in 25 at 20.574 inches from muzzle.

[2] Model of 1895.

[3] Model of 1895 MI.

12-INCH GUNS.

These guns resemble so closely the 10-inch gun of same-named model that a detailed description is unnecessary.

The number of C hoops has been successively reduced from ten in the type gun to six in model of 1888, to five in model of 1888 Mi, to three in model of 1888 Mi½, and to two in model of 1888 Mii. The D hoops have been reduced from five in the type gun to two in model of 1888 and of 1888 Mi and to one in all later models. The B hoops have been reduced from eight in the type gun to four in model of 1888 and to three in all later models, except 1900, which has but two. The A hoops have been reduced from seven in the type gun to five in model of 1888, to four in model of 1888 Mi, and to three in all later models, except model of 1900, which has but two.

The breech mechanism is the same, except in dimensions, as that of the 10-inch gun of the same model, except that in the 12-inch gun ball bearings are introduced into the tray hinge to carry easily the greater weight, and 12-inch guns model of 1888 mounted on D. C. carriages model of 1896 have a modified form of tray lock latch handle, and that in the model of 1905 the number of turns of the operating crank and the number of teeth on the compound gear and worm wheel are increased over the corresponding number for 10-inch guns.

MODEL OF 1888 Mi½.

Only a few guns of this model were made. They are like the model of 1888 Mii, except in the number of C hoops and the shape of the D hoop.

MODEL OF 1892 (1896).

But one gun of this model was made. It was originally called model of 1892. Its breech mechanism was changed to a design similar to model of 1895, except that the operating crank was above instead of below the tray. It was then called model of 1896.

This gun was kept at Sandy Hook Proving Ground for proof purposes.

MODEL OF 1900.

This gun has the same breech mechanism and firing mechanism as the model of 1895 gun. It differs from previous models in length and weight and in dimensions of the powder chamber. The powder chamber has been modified by the addition of a fixed tray of gun steel, permanently screwed in place, reducing the chamber capacity by 975 inches.

The principal weights, dimensions, etc., of the 12-inch guns are as follows:

		Models of 1888.	Model of 1895.	Model of 1900.
Weight, about	pounds	117,127	115,000	132,380
	tons	52	53.2	60.2
Total length	inches	439.92	442.56	504.35
Length of bore	calibers	34	35	40
Maximum diameter of breech	inches	46.2	44.5	48.5
Diameter of muzzle	do	20.2	21	22
Diameter of trunnions	do	14.5	14.5	14.5
Distance between rimbases	do	50.2	50.2	50.2
Distance of axis of trunnions from muzzle	do	291.1	289.6	337.555
Rifling:				
Number of grooves		72	72	72
Width of grooves	inch	0.3736	0.3736	0.3736
Depth of grooves	do	0.06	0.06	0.06
Width of lands	do	0.150	0.15	0.15
Twist of rifling	calibers	1 in 50 to 1 in 25 at 24 in. from muzzle.	1 in 50 to 1 in 25 at 36 in. from muzzle.	1 in 50 to 1 in 25 at 35.04 in. from muzzle.
Powder chamber:				
Diameter	inches	14.2	14.2	16.50
Length	do	77.68	77.68	85 Cylindroconical.
Capacity	cubic inches	12,185	12,185	16,514
Total capacity of bore	do	50.900	51,371	61,779
Powder charge:				
Weight of charge	pounds	279	279	334
Density of loading		.6339	.6339	.5598
Projectile:				
Weight of projectile (filled)	pounds	1,046	1,046	1,046
Ratio of weight of projectile to weight of piece		1 to 112.	1 to 110.	1 to 126.
Length of projectile	calibers	3.5 4.5	3.5 4.5	3.5 4.5
Sectional density $\frac{W}{d^2}$		7.264	7.264	7.264
Travel of projectile in bore	inches	331.12	342.32	395
Muzzle velocity	foot-seconds	2,250	2,250	2,250
Pressure per square inch in powder chamber	pounds	37,000	38,000	30,000
Muzzle energy	foot-tons	36,754	36,754	36,754
Penetration in Krupp armor—capped projectile:				
Muzzle	inches	19	19	19
1,000 yards	do	17.8	17.8	17.8
5,000 yards	do	13.6	13.6	13.6

INSTRUCTIONS FOR THE CARE OF THE BREECH MECHANISM OF SEACOAST CANNON.

8-INCH, 10-INCH, AND 12-INCH GUNS WITH BREECH PLATES, MODEL OF 1888.

1. Care of the Rotating Mechanism.—The mechanism for rotating the breechblock of these cannon is housed within the breech plate, which is attached to the rear face of the gun by means of screws.

This breech plate should not be removed from the gun except for the purpose of examination, cleaning, or repair. The remainder of the breech mechanism, as breechblock, obturator spindle and nut, gas-check pad and rings, tray and hinge pin, translating roller and crank, tray latches and catches, and rotating crank, are detached from the gun and packed in boxes provided for this purpose when the gun is not mounted or for shipment. All interior woodwork of the packing boxes should receive two heavy coats of asphalt.

The construction of the breech plate is such as to protect the mechanism which it contains for a considerable length of time against the oxidizing influence of the atmosphere on the seashore. The breech plate is also dust proof. At the top of the plate are oil holes, which are closed by means of screws. In assembling the rotating gearing on the breech plate at the gun factory the different parts are assembled dry. After attaching the breech plate to the gun, and during the final working trial at the factory, the oil screws referred to must be removed and a liberal amount of oil of a quality equal to pure sperm oil, that will not corrode the metal of the breech mechanism nor become dry or gummy, must be poured in through the oil holes, and the rotating gearing must be operated during this process (the tray with the breechblock may be in the loading position during that time). The oil-hole screws will be replaced. The gun must not be shipped or stored in the open air unless the rotating mechanism has been oiled thus thoroughly.

2. Assembling the Breech Mechanism after the Gun has been Mounted on the Carriage.—The breech recess, also all surfaces of contact with parts of the breech mechanism, will be carefully cleaned and all traces of rust removed. Those parts of the mechanism which are contained in the packing boxes will be cleaned also. The rotating

crank will be attached to the squared stud near the top of the breech plate for operating the rotating gearing. Should the latter work easily and freely, the assembling of the remainder of the parts of the breech mechanism can be proceeded with. If, however, the rotation of the mechanism is attended with some difficulty, lubricating oil will be poured in liberally through the oil holes (the heads of the screws closing oil holes are stamped "Oil hole") at the top of the breech plate and the rotating gearing will be kept in motion till the difficulty has disappeared.

If, however, the defect has not been removed in this manner, then it will be necessary to remove the breech plate from the gun for examination. For this purpose the eyebolt which will be found in the implement chest, is screwed into the oil hole (the rear oil hole on 10-inch and 12-inch guns), the hook of the loading crane is brought above the eyebolt, and the latter is attached to the former by means of a suitable piece of rope. Should a loading crane not exist on the carriage, then a light gin will be used for handling the breech plate. The screws securing the breech plate to the gun will be removed, and the breech plate will be carefully taken off and will be placed upon pieces of board, the forward face, exposing the mechanism, on top.

The rotating ring and the pinions with their shafts will be removed and carefully cleaned, also all contact surfaces between the movable and the fixed parts.

Before removing the gearing it should be noted whether the teeth are marked to indicate the proper position for reassembling. If not, prick-punch marks should be made opposite each other on engaged tooth and space, while in either open or closed position, to show the proper arrangement of the gearing for reassembling.

The oil grooves must be cleaned also.

Any burs that may be discovered on working surfaces must be removed with file and emery cloth in a proper manner.

The gearing will be replaced and the breech plate attached to the gun and secured to it properly.

Lubricating oil will be poured in through the oil holes and the latter will be closed.

The rotating mechanism being in proper order, the sector projecting from the interior surface of the rotating ring, which engages the slot in the breechblock, is brought to cover the upper right-hand threaded sector of the breech recess. While in this position the rotating crank is placed upon the square stud of the rotating pinion, the handle horizontal and to the right.

If the tray back latch, which locks the tray to the gun in the loading position, was not put in place before the breech plate was attached to the gun, it will be assembled now as follows: The pivot screw will be removed from the breech plate and the handle will be removed from the back latch. The latch will then be inserted in the slot on the side of the breech plate, and pivot screw and handle returned to place.

The tray will now be assembled. For convenience it should be placed first on a wooden support upside down, resting on the guides.

The square bolt lock will be inserted in its recess, the cam (with links attached) will be assembled by means of its pivot bolt in such a manner that its forward part engages the cam recess in the lock bolt, which is flared out toward the rear, and that the flat bosses on its rear end bear against the bottom of the tray slot.

The spring lock will be put in place and the tray latch will be assembled by compressing the spring lock sufficiently for the insertion of the latch pivot.

Finally, the cam links will be connected to the rear arm of the latch, and the tray is ready for mounting.

If, for any reason, the tray should have been assembled to the gun before the latch, lock bolts, etc., were attached to it, the latter will be assembled in the same manner as described above.

In assembling the tray to the gun it must be seen that the hinge pin and its bearings are clean and bright. The oil hole and the oil grooves must be also cleaned. The hinge pin will be oiled during and after its insertion.

The breechblock will be assembled as follows: The tray will be swung in the loading position, in which it is held by the tray back latch. The translating roller must be removed if it should have been put into the tray previously, but this should not have been done. The obturator spindle and gas-check pad will be removed from the breechblock, a rope sling will be passed over the threads around the center of the breechblock and at right angles to its axis, the block being in translating position—i. e., the translating stud at its rear end pointing downward. The sling will be attached to the hook of the loading crane or the gin. The breechblock will be hoisted until it can be swung into the breech recess; it will be inserted as far as the rope permits. A handspike will be inserted into the spindle cavity, and by means of this two or three men can hold the block in place while the position of the rope sling is being changed farther back. The block will now be forced into the breech recess and rotated till the rotating crank reaches its vertical terminal position.

The tray will now be swung to the breech plate and the translating roller screwed into the tray for the first time. The translating roller should not be screwed home with the tray in any other than the firing position, otherwise the rear end of the tray latch would have to be lifted up to the proper height to prevent interference between the lock bolt and the translating roller.

In case neither loading crane nor gin are available, the shot truck may be utilized. The breechblock is rolled onto the truck by means of a plank ramp, and supported thereon in its proper position by means of bits of wood. The shot truck will then be adjusted to the proper height and angle and the breechblock forced into the breech recess and rotated, as above described.

The last operation of inserting and adjusting the obturator spindle is to be performed as follows: The breech will be opened and breechblock and tray swung into the loading position. The obturator spindle, with the split rings and pad in place, will be inserted into the breechblock and will be secured by screwing the obturator nut on the rear end of the spindle. The breechblock is then translated and rotated halfway into firing position and the wrench applied to the large nut, which is tightened as much as possible by one man. The clamping screw on the obturator nut should then be tightened. This screw should be set up only moderately hard. The spindle is properly adjusted if, while it has no play longitudinally, the spindle can be turned around freely by taking hold of obturator-spindle head with both hands.

If, after firing a few rounds, the spindle is found to have longitudinal play, the adjusting operation above described is repeated. The proper adjustment of the obturator spindle is of great importance.

Should the obturating pad offer too much resistance against rotation, it will have to be exchanged, or the fact will have to be reported to the proper authority for relief.

The translating roller and all other parts of the tray mechanism should be lubricated, for operation, with grease or oil of a quality that will not corrode the metal nor become dry, sticky, or gummy. Engine oil No. 1 is issued for lubricating purposes, except for translating rollers, for which No. 4½ lubricant and graphite are prescribed.

Should sand, or an improper lubricant, cause the translating roller to move with difficulty, the roller should be removed from the tray and wiped off clean. The same remark applies to the operation of locking bolts and latch.

3. EXAMINATION OF THE BREECH MECHANISM OF MOUNTED GUNS.—The breech mechanism of mounted guns should be operated at least once in each week, and such parts of it as need cleaning should receive proper attention. The breech plate should not be removed for examination unless the operation of the rotating mechanism is attended with some difficulty which can not be overcome by the injection of oil through the oil holes.

10-INCH AND 12-INCH GUNS, MODELS OF 1895 AND 1900, AND 14-INCH AND 16-INCH GUNS.

1. Care of the Breech Mechanism.—When the gun is not mounted, or for shipment, all parts of the breech mechanism, except the hinge plate and the tray-latch catch, will be detached and packed (slushed thickly with slushing oil, cosmoline, or any other suitable material) in the packing boxes provided for the purpose.

All interior woodwork of such packing boxes should receive two heavy coats of asphalt.

2. Assembling Breech Mechanism after the Gun has been Mounted on the Carriage.—The breech recess, also all surfaces of contact with parts of the breech mechanism, will be carefully cleaned and any traces of rust removed.

All parts of the breech mechanism contained in the packing boxes will be carefully cleaned also.

In assembling the breech mechanism the worm shaft with its ball bearings will be put into place first. Insert one ball bearing into seat at inner end of worm recess. Assemble other ball bearing on worm shaft outside of worm and insert worm shaft with this ball bearing into recess. Then put the threaded bronze bushing into place and screw entirely home, when its collar will be in perfect contact with the hinge plate.

The tray will be assembled next, with its ball bearing, tray latch, and catch bolt. The hinge pin will be slipped into place to support the tray and allow it to be swung into position to receive breechblock. The obturating spindle with the gas-check pad, split rings, and disk will be removed from breechblock so that block can be suspended by a rope sling through hole in breechblock, this rope sling to be hung from a gin or crane erected for the purpose.

The breechblock will be hoisted until its guide grooves are opposite the guide rails of the tray, and will be pushed on from the front of tray (as stops would prevent the opposite), taking care that the breechblock is horizontal.

Note that in the 12-inch gun the tray must be rotated till its front surface is parallel to the axis of the gun when the block is being slid into place, as otherwise the rear of block would not clear the upper hinge lug.

Disengage rope from block.

Swing tray with block against end of gun, push the block into breech recess of gun, shoving it entirely home, but do not rotate it.

The tray should now be supported by blocking or otherwise, so that the hinge pin may be withdrawn. After which hold in position the spiral gear with the face having cylindrical hub uppermost, the two teeth marked *A* and *B* being inserted into spaces marked *A* and

B on rotating rack of block. The vertical line engraved on the spiral gear must now be coincident with that on the upper hinge lug. Insert hinge pin with vertical line thereon coincident with above and lower gently through spiral gear and tray and lower hinge lug, but not below the latter. Hold in this position while bronze worm wheel is put into place, as follows: The worm wheel has upper face marked "Top," and the marked spaces of wheel *must engage the similarly marked teeth of the worm.* The worm wheel should now be rotated by the worm (so that proper engagement of the teeth is preserved) until the line engraved upon wheel coincides with the beforementioned vertical line of hinge lugs and spiral gear and hinge pin. Then hinge pin can be lowered completely into place, and nut at bottom screwed on, and the locking pin driven through nut and hinge pin.

The crank handle should be placed upon the worm shaft in the position indicated by the engraved line and the set screw.

The insertion and securing of the spindle will be performed as follows: With the breechblock in loading position, the spindle, with split rings, gas-check pad, and gas-check disk upon it, will be inserted into the block. The large ball bearing will be put in place upon rear end of spindle projecting through block, and spindle secured by screwing up by hand the spindle nut. The adjustment of the spindle is the same as for model of 1888 guns.

(If, after firing a few rounds, the spindle is found to have longitudinal play, as it should, and probably will, it should be set up as above.)

3. EXAMINATION OF THE BREECH MECHANISM OF MOUNTED GUNS.—The breech mechanism of mounted guns should be operated at least once in each week, and such parts of it as need cleaning should receive proper attention. If necessary, the tray will be removed in order to clean the worm, worm shaft, and spiral gear, and their recesses. Split rings should be periodically dismantled, cleaned, and lubricated.

The mechanism should be oiled whenever necessary, especially the worm shaft and the hinge pin.

The lubricating oil should be of a quality equal to engine oil No. 1, it should be noncorrosive (free from acids) and should not become dry or gummy.

14-INCH GUNS, MODEL OF 1907.

This gun is of the wire-wound type and except the wire, the breech bushing, and the A and N rings the gun proper is of gun steel. The wire is of steel of high physical properties, the breech bushings and the A and N rings are of forged steel "C." The gun is composed of a tube on which are shrunk the A, B, and N rings, the latter in addition being threaded on to the tube. The wire is first wound on the muzzle portion of the gun, the various rings being assembled during the operation of winding. The rings B, C, D, E, F, and G serve a means of locking the tube and jacket together. The jacket is also locked to the tube by means of a breech bushing screwed into the breech of the jacket and resting against the end of the tube. These rings are used for the purpose of securing a means of beginning and ending each wired section. Each section is made up of a continuous length of wire. The different spools of wire are brazed together with a silver flux between a scarf joint. The H, J, L, M, and N rings are also used as terminating points of the several muzzle hoops.

The finished length of the tube is 481 inches. Upon the breech portion of the wire-wound construction is assembled the jacket, the rear 14 inches of which extends beyond the tube and serves as a seat for the breech bushing. The finished length of the jacket is 264.5 inches. Forward of the jacket are assembled successively the C–1, C–2, C–3, and C–4 hoops, their respective lengths being 56 inches, 56 inches, 56 inches, and 62.5 inches. The forward or C–4 hoop is locked to the N threaded ring by four steel pins 90° apart. The wire used in this construction is one-eighth inch square. It is wound on the breech section at a tension of 42,900 pounds per square inch and on the muzzle section at a tension of 46,500 pounds per square inch. Upon the jacket and over the center of gravity of the gun is assembled the trunnion hoop, which has a total finished length of 32 inches. The trunnion hoop is locked to the jacket by means of two shoulders of different heights. The jacket has also machined on its exterior two ribs between which is located the elevating arm band. A hole 1.875 inches in diameter is drilled to a depth of 0.15 inch on each side of the elevating band seat serving as a means of securing the band against rotation. The breech bushing is screwed into the extreme 14 inches of the jacket which overhangs the tube. It is prevented from rotating by the hinge, which is milled into the face of the gun and the bushing. The breech bushing is threaded and sectored to correspond to the block. The rifling curve of this type of gun is right-handed and increases from one turn in 50 calibers at the origin to one turn in 25 calibers at a point 22.8 inches from the muzzle end, after which it is uniform (one turn in 25 calibers) to the muzzle.

14-INCH GUNS, MODEL OF 1907 MI.

This gun is of the built-up type, solid gun-steel construction except the breech bushing, which is of forged steel "C." It is composed of a tube the length of which is 481 inches. Upon the tube are assembled the C–1, C–2, C–3, and C–4 hoops, the latter being locked to the C–3 hoop and to the tube by means of shoulders. The lengths of these hoops are respectively 162 inches, 105 inches, 97 inches, and 131 inches. With the exception of the C–4 hoop these are assembled in succession, the C–4 hoop being the last except the trunnion hoop to be assembled to the gun. Upon the C–1 hoop and extending partly over the C–2 hoop is assembled the A–1 hoop, which has a length of 197.5 inches. The hoop is locked to the adjoining parts by means of shoulders and the breech bushing. Upon the A–1 hoop is next assembled the B–1 hoop, which has a total exterior length of 188 inches, the breech 14 inches, of which serves as a seat for the breech bushing in which it is threaded. This hoop is locked to the A–1 hoop by means of a shoulder and by the breech bushing. The D–1 hoop, with a length of 80 inches, is next assembled and locked to the A–1 hoop by means of a locking recess. The D–2 hoop, with a total length of 96 inches, is next assembled, locking together the C–2 and the C–3 hoops, followed by the assembling of the C–4 hoop, which is locked to the tube and the C–3 hoop by means of shoulders.

The trunnion hoop is last assembled. It has a length of 28 inches and is locked to the B–1 hoop by means of two shoulders of different heights. The exterior of the B–1 hoop is machined for the recoil band in a similar manner to the 14-inch gun, model of 1907.

The breech bushing is made of forged steel "C" and screws in the overhang of the B–1 hoop. It is prevented from rotation by the hinge in the same manner as in the 14-inch gun, model of 1907. It is threaded and sectored to correspond to the breechblock.

The rifling curve of this model gun is right handed and increases from one turn in 50 calibers at the origin to one turn in 25 calibers at a point 22.8 inches from the muzzle, after which it is uniform, continuing (one turn in 25 calibers) to the muzzle.

14-INCH GUNS, MODEL OF 1909.

This gun is of the wire-wound construction and similar in that respect to the 14-inch type, model of 1907.

The gun is composed of two tubes, A and B, each 565 inches in length. The purpose of these two tubes is to limit the extension of thermal cracks in the bore to the inner or A tube. These tubes are first assembled with only a moderate shrinkage, having one shoulder ¼ inch high located at a point 100 inches from the breech end of the tubes. The gun is constructed wholly of gun steel, except the spool and step rings, the breech bushing, and the wire. These rings and the breech bushing are of forged steel "C" and the wire has very high physical properties. Upon the assembled tubes the A, C, and L rings are shrunk, the latter in addition being threaded to the exterior tube. This construction is in every respect similar to the one described for the 14-inch guns, model of 1907. Upon the breech end of the wire-covered tubes is assembled the jacket which extends beyond the end of the tubes 14 inches, and which serves as a recess for the threaded breech bushing. The total length of the jacket is 246.5 inches. In order to lock the C–1 hoop to the jacket the locking hoop is first assembled to the C–1 hoop, engaging it by means of a shoulder. The two assembled hoops are then assembled to the gun, the locking hoop engaging the jacket by means of the shoulder. The length of the locking hoop is 24 inches and the length of the C–1 hoop is 144 inches. The assembling of the C–2, C–3, and C–4 hoops follows, which have respective lengths of 63 inches, 63 inches, 62.5 inches. The C–4 hoop is secured to the muzzle L ring by eight securing screws. This type of gun is intended for a barbette mount, no trunnions being provided. For guiding the gun in its sleeve a forged-steel key 72 inches in length is sunk in the top element of the gun and secured by five steel screws.

The guns of this model are identical except that one-half the number manufactured are equipped for right-hand mechanisms and the other half for left-hand mechanisms, this arrangement being for turret purposes. This causes correspondingly different locations of the hinge and other breech-mechanism parts which form part of the gun. The recoil band for these guns is assembled at the extreme breech end of the gun, a shoulder on the band engaging a corresponding shoulder on the jacket of the gun. The length of the band is 20 inches. It is secured from movement to the rear by four recoil band-securing plates which screw into the rear face of the band and rest in four milled-out recesses in the jacket. The height of their contact is 0.25 inch, each securing plate being 31° on a radius of 21.15 inches in length. The band is prevented from rotating by a recoil band key located partially in the band and jacket.

The breech bushing of this type of gun is of forged steel "C" and is threaded into the rear 14 inch of the jacket. It is secured from rotation by means of the hinge, in a similar manner to the other 14-inch types. It is threaded and sectored to correspond to the breech-block. The breech part of this gun has six gas-ejector holes whose exterior openings are just to the rear of the recoil band, their interior openings coming out midway at various points in the thread box. These air passages have for their purpose the injecting of air into the gun to force all gases out of the muzzle as soon as the gun has been fired. This precaution is taken for the reason that these guns are to be mounted in turrets. The exterior openings of these holes will be connected to the compressed-air supply.

The rifling of this type of gun is right handed and increases from one turn in 50 calibers at the origin to one turn in 25 calibers at a point 28.8 inches from the muzzle end, after which it is uniform (one turn in 25 calibers) to the muzzle.

14-INCH GUNS, MODEL OF 1910.

This type of gun is similar, except for the method of mounting and the rifling curve, to the model of 1909. A description of it is therefore unnecessary. This type of gun is arranged for mounting on a disappearing carriage and the trunnion hoop serves the purpose of the locking hoop of the 1909 type, obviating its use, the trunnion locking the jacket to its forward hoop. There are other slight differences, mainly in the diametrical dimensions, as for instance, the maximum exterior diameter of the jacket of the 1909 type is 1.7 inches larger than the corresponding dimension on the 1910 type.

The rifling curve of this type of gun is right handed with a uniform twist throughout of one turn in 25 calibers.

BREECH MECHANISMS OF 14-INCH GUNS, MODELS OF 1907, 1907MI, AND 1910.

The breech mechanisms for these several types of guns are identical. The principal parts consist of the hinge, hinge pin, operating crank, operating worm, worm wheel, tray, tray latch, tray-latch catch, compound gear, and breechblock.

1. *Hinge.*—The hinge is secured on the breech face of the gun by means of seven large screws. It possesses two lugs bored for the reception of the hinge pin. At its extreme lower end it has an additional lug bored out for the reception of the operating worm. The hinge, in addition, serves the purpose of preventing the rotation of the breech bushing in its seat.

2. *Hinge pin.*—The hinge pin fits in the lugs of the hinge, being supported on the upper lug by a collar which is a part of the hinge pin. To it are attached the compound gear and the worm wheel, and between the two hinge-pin lugs is the tray. The tray is not fixed to the hinge pin, but revolves about it. The hinge pin is grooved for the purpose of permitting a flow of oil to the different parts.

3. *Operating crank.*—The operating crank is secured to the worm on its squared end and held there by means of a set screw.

4. *Operating worm.*—The operating worm is set in the lower hub on the hinge. It has two ball-bearing washers, one on each side of the worm, secured by a threaded housing. These bearings reduce the friction due to the thrust when the worm engages the worm wheel.

5. *The worm wheel.*—The worm wheel is secured to the hinge pin by being fitted on its squared end. It is held in place on the hinge pin by a nut, and this nut is pinned to the hinge pin to prevent its backing off.

6. *Tray.*—The tray is suspended on the upper surface of the lower hinge lug and held in position by the hinge pin passing through the two hinge lugs. The compound gear is assembled directly beneath the upper lug and rests on the top of the tray. This gear is secured by means of two keys to the hinge pin. There is a ball-bearing washer between the upper part of the lower hinge lug and the lower edge of the tray to permit easy rotation. The tray is profiled to fit corresponding profiles in the lower part of the block. The tray is held to the face of the gun, when in that position, by means of a tray latch which fits in the tray-latch catch, the latter being secured in the milled recess on the face of the gun and held by means of two screws.

7. *The tray latch and tray-latch catch.*—The tray-latch catch has a plunger set in it actuated by a spring. This plunger is called the tray-latch plunger. The tray latch has a plunger passing through it which is called the tray-latch operating stud. To the rear of the tray-latch setting in the tray is located the tray-latch lock bolt, actuated by a spring. The tray latch is suspended from the tray by means of a tray-latch pivot which passes through it. The tray-latch lock bolt prevents the latch from rotating or tipping by entering a hole in the latch, which hole is the seat for the tray-latch operating stud when the latter is forward. The action of the tray latch is as follows: When the tray is closed against the face of the gun the operating stud passing through the latch is forced to the rear by its forward end striking the face of the gun. This forces out of the seat in the latch the tray-latch lock bolt. The latch striking the tray-latch plunger located in the tray-latch catch tips the latch so that its forward end is on a level with the tray, the lower forward point of the latch engaging its seat in the catch. The block is then free to go forward. These movements are, of course, automatic and occur when the block on its tray is swung around for entering the breech recess. On the bottom of the block is a rectangular milled-out recess in which a rectangular web is left. The rectangular web thus left in the bottom of the block fits into a corresponding recess on the top of the tray latch. When the block is withdrawn this web comes into contact with the latch, tipping it and unlocking the tray from the face of the gun. At the same time the rectangular recess in the upper part of the latch engages in the rectangular web on the block, thus locking the tray to the block. In this position of the latch the tray-latch operating stud goes forward and allows the tray-latch lock bolt to engage in the latch, preventing any tipping. When the tray is closed the operation is the reverse. The tray-latch operating stud is forced back, thus forcing out of its recess the lock bolt. The latch is tipped by the tray-latch plunger, the tipping causing the latch and the catch to engage. The web on the breechblock being free, the block is permitted to go forward.

8. *Compound gear.*—The compound gear is attached to the hinge pin by means of two keys. About one-half of this gear is cut spiral and the other half cut spur. The spiral part engages in the spiral rack cut on the breechblock and causes the block to revolve. The spur part engages the translating rack cut on the breechblock and is used for translating the block in and out. The spiral part of the gear is of less diameter than the spur, so that more clearance is given to the loading of the projectile as that part comes in line with the bore when the block is opened ready for loading.

9. *The breechblock.*—The breechblock has a ratchet form of tooth rounded at top and bottom. It is of the Weldon type or step type, divided up into 12 sectors, 9 of which are threaded and 3 unthreaded. It thus only requires 30° of rotation to disengage the threads on the block from those located in the thread box or breech bushing. On the breechblock is machined the spiral rack for rotation and the spur rack for translation.

The firing mechanism of this type of gun is the same as that used in other large guns in the service, the only difference being in the lengths of the safety bar and guide bar.

The spindle, filling-in disk, and split rings are similar in construction to other large-caliber guns. Both of the large split rings are centered by means of shoulders to the obturator spindle and the filling-in disk. This is for the purpose of preventing sagging of these parts.

Operation of the mechanism.—This mechanism functions by a continuous movement of the operating crank. To open the gun the crank is turned to the right a total of 9.90 turns, of which amount 2.79 are necessary to rotate, 4.22 are for translating, and 2.89 to swing the block clear. In closing, the reverse is the case. Individual description of the functioning of each of the parts composing the breech mechanism during the operation is unnecessary, as the description given of these individual parts plainly shows how they function during their active operations. The rotation of the block in closing is limited by a filler or strip attached to the side of one of the threaded sectors, which comes into contact with the side of its adjoining sector.

14-INCH BREECH MECHANISMS, MODEL OF 1909.

This mechanism is in principle similar in all respects to the models of 1907, 1907 M_I, and 1910, 14-inch guns, except that it is arranged for electrical operation in turrets. The operating crank is located on its seat in the upper part of the hinge instead of the lower part of the hinge, as is the case with the other 14-inch types. This causes a corresponding change in the location of the wormwheel and the operating worm. The guns of this type and their breech mechanisms are constructed right and left handed for turret purposes.

These guns when mounted in turrets are equipped with the salvo latch shown on drawing 61–7–18, which prevents the breechblock being opened in case of a misfire until the latch has been tripped, which operation is intended to serve as a warning to the gun crew that a misfire has occurred. In order to accomplish this purpose it is essential that the gun crew be not trained to trip this salvo latch as part of the ordinary routine of opening the block because the latch would then lose its value as a signal of caution or warning. To this end it is intended that the device should be attached to its gun only during target practice or service action.

Operation of the breech mechanism.—It is the continuous-movement type, similar in all respects to the other 14-inch models, requiring the same number of turns of the crank to open and close the breech.

The principal weights, dimensions, etc., of the 14-inch guns are as follows:

	Model of 1907.	Model of 1907 MI.	Model of 1909.	Model of 1910.
Weight, pounds	111,900	118,700	139,240	137,300
Weight, tons	50	53	62	61
Total length, inches	495	495	579	579
Length of bore, calibers	34	34	40	40
Maximum diameter of breech, inches	44	44	45.7	44
Diameter of muzzle, do.	22.8	22.8	23.8	22.8
Diameter of trunnions, do.	14.5	14.5	No trunnions.	14.5
Length of trunnions, do.	9.25	9.25	....	9.25
Distance between rim bases, do.	48.2	48.2	....	48.2
Distance of axis of trunnions from muzzle, inches	318.3	319	C. of G. 380.88	371.4
Rifling:				
Number of grooves	126	126	126	98
Width of grooves, inches	0.2091	0.2091	0.2091	0.2088
Depth of grooves, do.	0.07	0.07	0.07	0.07
Width of lands, do.	0.14	0.14	0.14	0.24
Twist of rifling, right hand increasing twist, calibers	1 in 50 to 1 in 25	1 in 50 to 1 in 25	1 in 50 to 1 in 25	Uniform twist 1 in 25.
Powder chamber:				
Diameter, inches	16.8	16.8	16.8	16.8
Length, do.	68.915	68.915	68.915	68.915
Capacity, cubic inches	15,000	15,000	15,000	15,000
Total capacity of bore, do.	79,430	79,430	92,494	92,494
Powder charge:				
Kind of powder	cse.	Nitrocellulose.	Nitrocellulose.	Nitrocellulose.
Weight of charge, pounds	340	340	340	340
Density of loading, do.	0.6271	0.6271	0.6271	0.6271
Projectile:				
Weight of projectile (filled), do.	1,660	1,660	1,660	1,660
Ratio of weight of projectile to weight of piece	1 to 67	1 to 72	1 to 84	1 to 82
Length of projectile (calibers), shot	4	4	4	4
Length of projectile (calibers), shell	4.5	4.5	4.5	4.5
Sectional density $\frac{W}{d^2}$	8.469	8.469	8.469	8.469
Travel of projectiles in bore, inches	407.21	407.21	491.21	491.21
Muzzle velocity, foot-seconds	2,150	2,150	2,220	2,220
Pressure per square inch in powder chamber, pounds	36,000	36,000	36,000	36,000
Muzzle energy, foot-tons	53,259	53,259	56,783	56,783
Penetration in Krupp armor (long-pointed projectiles):				
Muzzle, inches	20.8	20.8	21.7	21.7
1,000 yards, do.	20.0	20.0	21.0	21.0
5,000 yards, do.	17.2	17.2	18.1	18.1

16-INCH GUN, MODEL OF 1895.

(Plate X.)

One gun of this type has been constructed. It is to be mounted on a disappearing carriage to form a part of the defenses at the western entrance of the Panama Canal. No other guns of this model and type are to be manufactured. A later type and model of 16-inch wire-wrapped gun is now under consideration.

The 16-inch gun, model of 1895, and its breech mechanism are similar in construction to 10-inch and 12-inch guns, model of 1895.

The principal weights, dimensions, etc., of the 16-inch gun, model of 1895, are as follows:

Weight	pounds tons	284,500 127
Total length	inches	590.9
Length of bore	calibers	35
Maximum diameter of breech	inches	60
Diameter of muzzle	do	28
Diameter of trunnions	do	19
Length of trunnions	do	13
Distance between rimbases	do	64.5
Distance of axis of trunnions from muzzle	do	380.5
Rifling:		
Number of grooves		96
Width of grooves	inches	0.3736
Depth of grooves	do	0.06
Width of lands	do	0.15
Twist of rifling (right hand increasing twist)	calibers	1 in 50 to 1 in 25
Powder chamber:		
Diameter	inches	19
Length	do	106.24
Capacity	cubic inches	29,624
Total capacity of bore	do	121,390
Powder charge:		
Kind of powder		Nitrocellulose
Weight of charge	pounds	650
Density of loading	do	0.6073
Projectile:		
Weight of projectile (filled)	do	2,400
Ratio of weight of projectile to weight of piece		1 to 119
Length of projectile	calibers — shot calibers — shell	3.5 4.0
Sectional density $\frac{W}{d^2}$		9,375
Travel of projectiles in bore	inches	451.86
Muzzle velocity	foot-seconds	2,250
Pressure per square inch in powder chamber	pounds	38,000

Muzzle energy .... foot-tons .. 84,328

Penetration in Krupp armor (long-pointed projectiles):

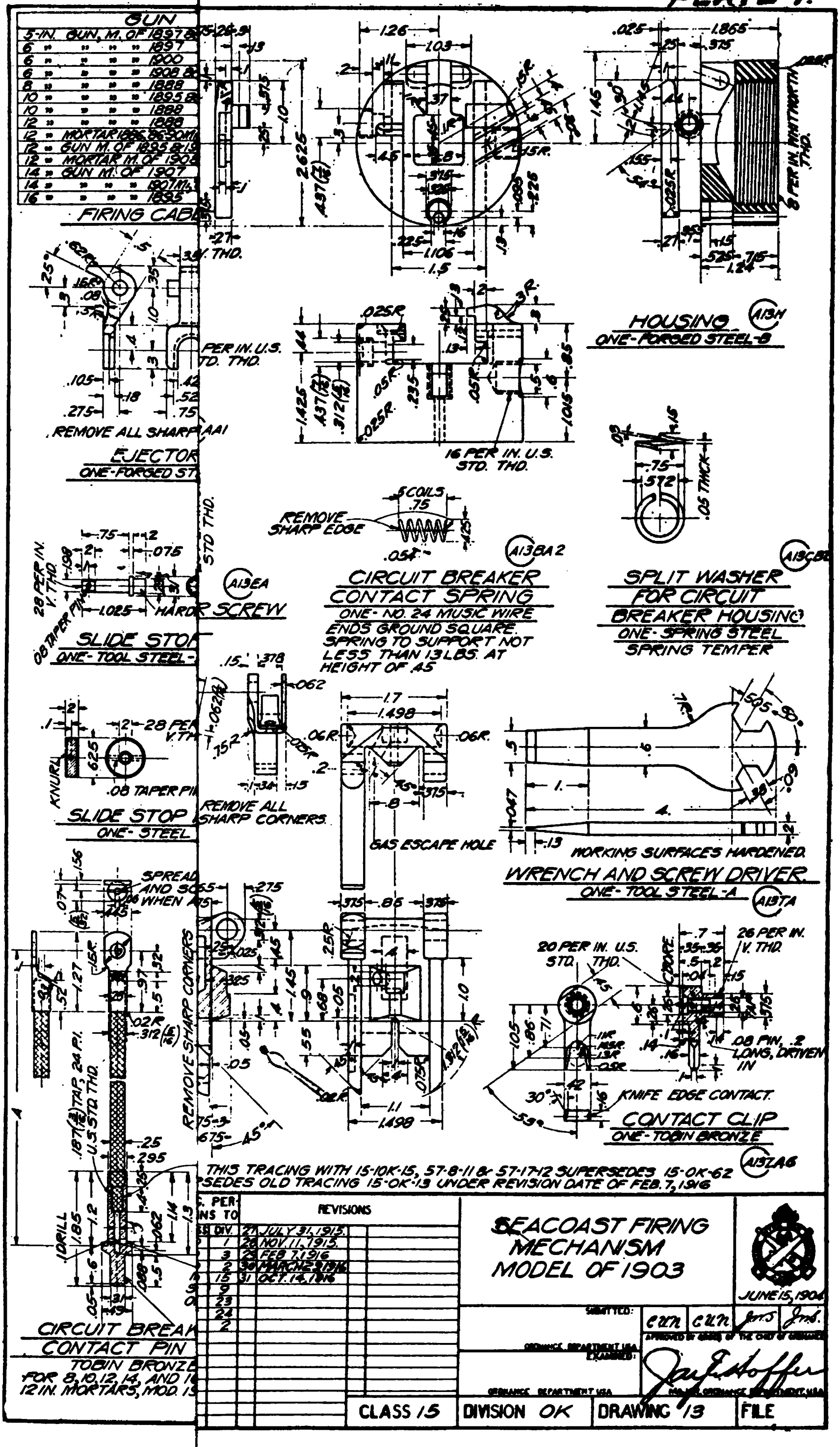
12 inches for all ranges, normal impact, maximum range, 19,300 yards.

Impact, 35° to normal penetration of 12 inches up to 17,700 yards.

WAR DEPARTMENT,
OFFICE OF THE CHIEF OF ORDNANCE,
Washington, June 20, 1917.

January 9, 1905.
Revised October 19, 1907.
Revised July 20, 1912.
Revised June 20, 1917.
11381—1192.
FORM No. 1665.
Ed. June 20—17–5,000.

PLATE I.



GUN
5-IN. GUN, M. OF 1897 &
6 " " " " 1897
6 " " " " 1900
6 " " " " 1908 &
8 " " " " 1888
10 " " " " 1895 &
10 " " " " 1888
12 " " " " 1888
12 " MORTAR 1886, 86, 90 M
12 " GUN M. OF 1895 & 19
12 " MORTAR M. OF 1908
14 " GUN M. OF 1907
14 " " " " 1907 M.
16 " " " " 1895

THIS TRACING WITH 15-10K-15, 57-8-11 & 57-17-12 SUPERSEDES 15-OK-62
SEDES OLD TRACING 15-OK-13 UNDER REVISION DATE OF FEB. 7, 1916

C. PER- NS TO		REVISIONS
DIV.	27	JULY 31, 1915.
1	28	NOV. 11, 1915.
3	29	FEB 7, 1916
2	30	MARCH 23, 1916
15	31	OCT. 14, 1916
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SEACOAST FIRING
MECHANISM
MODEL OF 1903

JUNE 15, 1904

SUBMITTED: CUN CUN JMS JMS

ORDNANCE DEPARTMENT USA
EXAMINED:

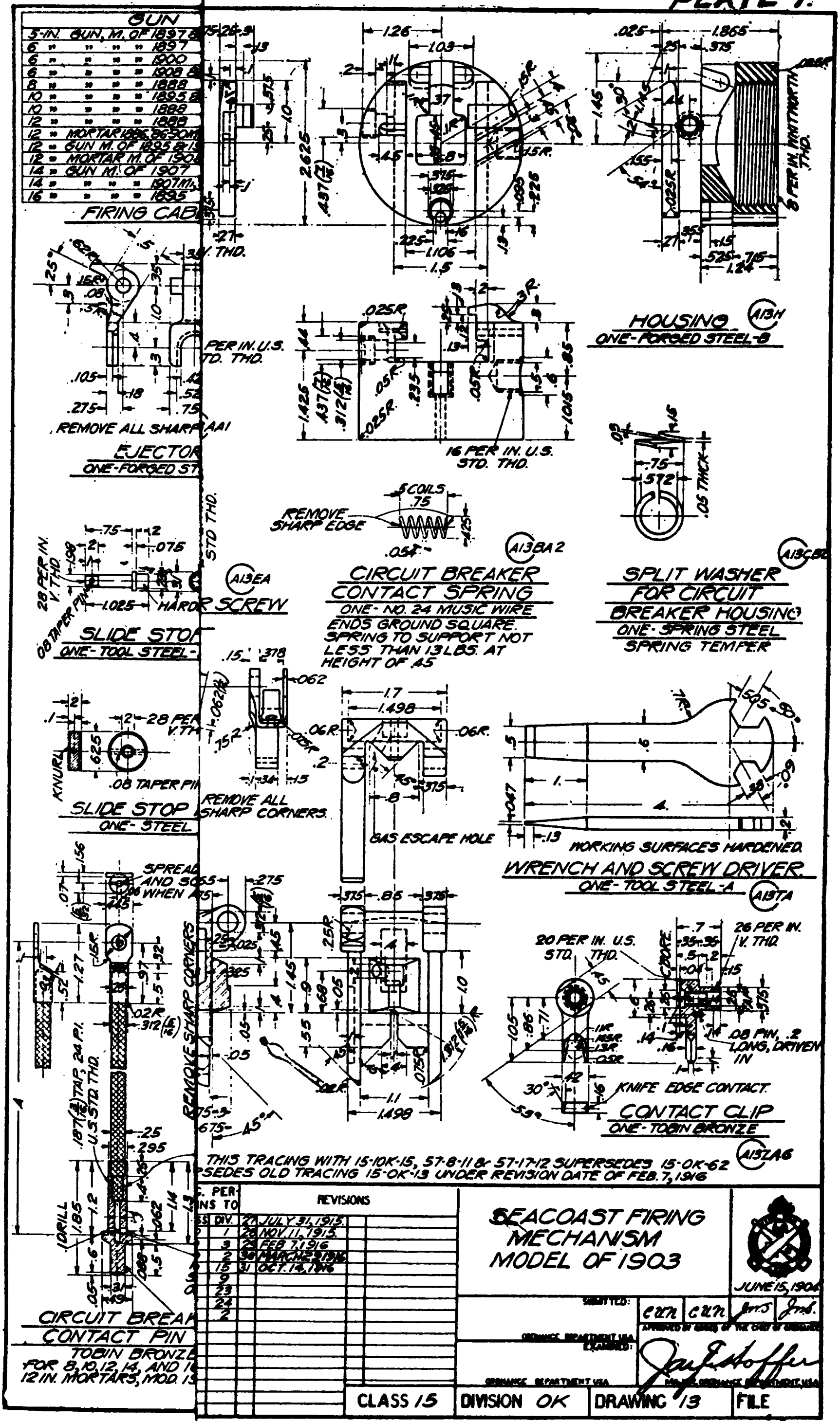
ORDNANCE DEPARTMENT USA

APPROVED BY ORDER OF THE CHIEF OF ORDNANCE

Jay E. Hoffer
MAJOR, ORDNANCE DEPARTMENT, USA

CLASS 15 | DIVISION OK | DRAWING 13 | FILE

PLATE I.



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8 " " " " 1888
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